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ALTERNATIVE INDUSTRIAL DEVELOPMENT PATHS FOR INDONESIA: SAM AND CGE ANALYSES

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ABSTRACT

In this article, we examine the economy-wide effects of three alternative growth paths for Indonesia's industrial sector using SAM (social accounting matrix) multiplier analysis and CGE (computable general equilibrium) modeling. The context of the analysis is the immediate post-crisis period — most likely to be in the next millennium — represented in our study by a modified benchmark data set for 1995. Special attention is given to the overall income and equity effects, considering that egalitarian growth has become a particularly important development objective in Indonesia. The results of SAM multiplier analysis indicate relatively strong macro-linkages from agricultural demand-led (ADL) industrialization, yielding a significantly larger increase in real GDP compared to that arising from industrial development oriented to either food processing or light manufacturing. The simulation results based on CGE modeling, which take account of nonlinearities and supply constraints that are ignored in SAM analysis, bear out the dominant influence of demand linkages in showing that ADL industrialization is associated with a larger GDP increase than the two industrial-led development paths. However, to preserve the income gains for farm households and improve equity, it would be necessary to prevent the agricultural terms of trade from deteriorating — for example, through improvement of the country’s ability to export farm products. Otherwise, food-processing-based industrial growth raises farm household income by more than the two industrial development scenarios. While industrialization based on light manufacturing shows the most significant increase in the ratio of manufacturing value added to GDP, it is also associated with the smallest GDP increase and the worst equity effect.

I. INTRODUCTION

Indonesia is currently in a deep political and economic crisis. One wonders, however, whether the situation was not any worse in the mid-1960s (just before the New Order government assumed power), given the country's economic stagnation, rapid inflation, and neglect of infrastructure since the early 1950s. Subsequently, the Indonesian economy grew impressively for most of the past three decades. Real GDP increased at an estimated average annual rate of well over 7 percent between 1970 and 1996 (based on World Bank data). Nevertheless, among Southeast Asian market economies, Indonesia still ranked lowest in 1996 — before the recent (and ongoing) crisis — in income per capita and level of industrialization. There is a continuing need to address longer term issues of economic development and industrialization in Indonesia even as the country faces difficult problems of crisis management and structural adjustment.

In this paper, we examine the economy-wide effects of three alternative growth paths for Indonesia's industrial sector using SAM (social accounting matrix) multiplier analysis and CGE (computable general equilibrium) modeling. The context is the immediate post-crisis period — most likely to be in the next millennium — represented in our study by a modified benchmark data set for 1995 (see below). Special attention is given to the overall income and equity effects, considering that egalitarian growth has become a particularly important development objective in Indonesia. The model simulations involve the promotion of productivity growth and capital formation focused on two industrial sub-sectors -- labor-intensive (or light) manufactures and processed food -- and the agricultural sector (i.e., crops and livestock). Since the early 1980s when oil exports, Indonesia's principal foreign exchange earner, began to suffer from sharply declining real prices, the government has encouraged export diversification into light manufactured goods — with significant results on export earnings, industrial production, and labor employment. Food processing, which has traditionally been the largest component of Indonesia's manufacturing sector, serves to enhance national food security and is characterized by relatively strong production linkages that can provide the basis for large output increases in the entire economy. On the other hand, what Adelman (1984) has termed "agricultural demand-led (ADL) industrialization" is promoted by income growth among farm households, which if broadly based, has substantial consumption linkages that can create a mass market for domestically produced goods, including in

particular labor-intensive manufactures, and provide the impetus to a rapid and equitable growth of the national economy (Mellor 1995).

Economy-wide modeling to analyze the growth and distributional effects of alternative development paths is preferable to a partial-equilibrium approach. The latter abstracts from many important factors that operate simultaneously and interactively, many of which are difficult to anticipate. Quantitative studies on the macro and distributional effects of development policies, such as the early work on South Korea by Adelman and Robinson (1978), typically find that there are strong interactions among various sectors of the economy that influence the direction and magnitude of policy effects.

The SAM (social accounting matrix) framework is a useful starting point for economy-wide analysis, which we employ to focus on the demand side. In the next section, we briefly describe the benchmark Indonesian SAM and calculate the multiplier (direct and indirect) effects of an exogenous income injection to each of the sectors being promoted by the alternative industrial development strategies. These income multipliers give indication of the relative strength of economy-wide linkage effects for different production sectors, assuming no supply constraint. We also calculate the income multipliers associated with different household groups, which have implications for the relationship between growth and equity.

Next, we present the structure of our CGE model of the Indonesian economy, which incorporates nonlinearities and endogenous prices that are ignored in SAM analysis. The CGE model is used subsequently to generate the comparative results of simulation experiments involving three stylized industrial development strategies. A benchmark social accounting matrix (SAM) for 1995 is modified to represent initial conditions for the model simulations after an assumed recovery of the Indonesian economy from the crisis. The paper ends with some concluding remarks.

II. THE BENCHMARK SAM AND INCOME MULTIPLIERS

A simplified framework for economy-wide analysis is shown in Figure 1. It traces the circular flow of incomes from product markets through factor payments to households and back to product markets through expenditures on final goods. Additionally, income flows involving producers, government, rest-of-the-world, and the capital account are included in the diagram.

<<Figure 1 >>

A social accounting matrix describes quantitatively, in a square table, the income flows taking place in an economy — such as those represented in Figure 1 — during a specified period of time.[1] Each account in the SAM is represented by a row and a column of the table; expenditures are shown in the columns and receipts in the rows. The SAM can be expressed either algebraically as accounting identities (stating that receipts must equal expenditures for each account), or as numbers that represent the data base for a given benchmark period (typically a year). The numerical SAM integrates national income, input-output, flow-of-funds, and foreign trade statistics into a comprehensive and consistent data set, as exemplified in Table 1 by an aggregate version of the official Indonesian SAM for 1995.

<< Table 1 >>

In the present study, we make use of a benchmark Indonesian SAM which has been adjusted from the official 1995 SAM to conform to our desired aggregation level and to reflect equilibrium conditions after Indonesia has achieved economic recovery. It distinguishes 17 production sectors (activities/commodities), 6 factors, and 7 household groups (see Table 2), with three accounts for government, one account each for enterprises, capital, and rest-of-the-world (ROW).[2] For present purposes, we identify the three crop and livestock sectors as the direct beneficiary of an agricultural demand-led industrial development strategy; similarly, the food processing and light manufacturing

[1] See Pyatt and Round (1985) for an early discussion of the SAM structure, and Robinson and Roland-Holst (1988) for perspectives on SAM-based modeling.

sectors are assumed to benefit directly from the policy regimes promoting the two other industrialization paths. The equity effect arising from each strategy will be evaluated in terms of the comparative income changes for the various household groups, with special attention to farm-worker, small-farm, nonfarm low-income, and urban low-income households.

<< Table 2 >>

Assuming exogeneity in some accounts (usually the government, capital, and ROW accounts), the algebraic SAM can be transformed into a multi-sectoral, demand-driven model of the economy in which the linkages among sectoral production, household incomes and expenditures, foreign trade, and macroeconomic balances are systematically taken into account. The SAM is partitioned so that the total income (row sum) in each endogenous account is equal to the sum of products of the expenditure coefficient and corresponding income plus the total exogenous income from the government, capital, and ROW accounts; that is,

$$Y = A_n Y + X \tag{1}$$

where Y is a column vector of total incomes in the endogenous accounts, X is a column vector of total exogenous incomes (the exogenous accounts in the partition), and A_n is the expenditure coefficient matrix pertaining to the endogenous accounts which is assumed fixed in conventional SAM modeling.

Equation (1) can be solved for Y in terms of X as follows:

$$Y = \left(I - A_n\right)^{-1} X = M_a Y \tag{2}$$

where M_a is the SAM multiplier matrix. Equation (2) can be used to calculate the endogenous incomes associated with any constellation of total exogenous incomes, given M_a. Also, the effects on Y arising from any given changes in X (e.g., an exogenous income injection in any production sector or in any household group) can be derived from equation (2). Each cell in the multiplier matrix indicates the total (direct and indirect) income change in the endogenous row account induced by an exogenous unit-income injection in the column account. It captures both the Leontief

[2] The disaggregate SAM is too large to be reproduced here, but is available from the authors on request.

(input-output) production linkages and the consumption expenditure linkages induced by changes in production activities through their effect on household incomes.

Based on our benchmark Indonesian SAM for 1995, the calculated income multipliers, representing the induced effects on GDP at factor cost, are as follows: 2.45 for food crops, 2.30 for nonfood crops, and 2.28 for livestock; 1.93 for processed food; and 1.71 for light manufactures. They correspond to the sum of the six factor-payment entries along each production-sector column in the multiplier matrix. Thus, SAM-based analysis allows us to infer that an increase in income of crop and livestock producers by one million Rupiahs will lead to a rise in GDP (at 1995 prices) by about 2.3 million Rupiahs, while the same income increase in the food processing and light manufacturing sectors will lead to GDP increases that are smaller by 16 and 26 percent, respectively. Evidently, the demand stimulus generated by agricultural growth significantly exceeds that by growth in either of the two industrial sectors. This finding lends support to the hypothesis that there are strong macro-linkages from rising agricultural incomes; a hypothesis favored by advocates of agriculture-based development.

The SAM model can also be applied to the analysis — again, focusing on the demand side — of the direct and indirect effects of exogenous income injections to different household groups. It is often noted that household expenditures of less affluent households are heavily oriented to locally produced, labor-intensive goods and services. By contrast, the consumption patterns of higher income households favor capital-intensive products of urban industry and imported goods. The latter implies relatively weaker and less labor-intensive linkages in the domestic economy. On this basis, it has been argued, with ample empirical evidence in developing countries,[3] that pro-equity growth measures do not necessarily hinder a favorable impact on overall income growth.

The calculated GDP multipliers for the seven household groups distinguished in the Indonesian SAM are shown in the first column of Table 3. It is notable that the three most affluent household groups — large-farm, nonfarm high-income rural, and high-income urban — are associated with GDP multipliers that are smaller than those for the lower income households. This result indicates that greater income benefits accruing to the latter households from any source (agricultural or nonagricultural) of economic growth would have a larger impact on overall income growth. Similarly, the comparative values of manufacturing output multipliers, shown in the second

[3] Among others, see Mellor (1976) on India, Adelman on South Korea (1984), Bautista (1997) on the Philippines, and Delgado et al. (1994) on a number of sub-Saharan African countries.

column of Table 3, suggest that income increases for less affluent household groups represent a more potent demand stimulus to industrial growth.

<< Table 3 >>

III. THE CGE MODEL

The CGE model of the Indonesian economy that we use in this study is adapted from a more disaggregated, agriculture-focused model developed earlier in Robinson et al. (1998) to analyze the economy-wide effects of trade liberalization and exchange rate changes under alternative rice policy regimes in Indonesia. Our model consists of five blocks of equations which are given in the Appendix below. It follows roughly the standard neoclassical specification of general equilibrium models (Dervis et al. 1982, Robinson 1989).

Markets for goods (or products), factors, and foreign exchange respond to changing demand and supply conditions which are influenced by government policies and the external environment. The model is Walrasian in that it determines only relative prices and other variables in the real sphere of the economy. Sectoral product prices, factor prices, and the foreign exchange rate are defined relative to an aggregate consumer price index, which serves to define the *numeraire*.

The production technology is represented by nested CES (constant-elasticity-of-substitution) and Leontief (fixed-coefficient) functions. Domestic output in each sector is a CES function of value added and aggregate intermediate input use. Value added is a CES function of the primary factors, while intermediate input use is defined by fixed input-output coefficients. It is assumed that land is mobile between the two crop sectors and that agricultural labor and nonagricultural production labor are substitutable.

Profit-maximizing behavior of producers determines factor demand. Factor market distortions are included, with the average return for a factor differing from the marginal revenue product of that factor in specific sectors. Each sector is assumed to produce differentiated goods for the domestic and export markets, sectoral output being a CET (constant-elasticity-of-transformation) function of the amounts sold in the two markets. Subject to this transformation function, producers maximize revenue from sales. Similarly, imported and domestic products are differentiated at the sectoral level. The composite (consumption) good is a CES aggregate, and consumers minimize the cost of obtaining a given amount of composite good. Such product differentiation permits two-way trade and gives some realistic autonomy to the domestic price system (de Melo and Robinson 1981). The associated price links are portrayed in the price transmission mechanism shown in Figure 2.

<< Figure 2 >>

Based on the small-country assumption, the domestic price of sectoral imports is represented in terms of the foreign price, exchange rate, and tariff rate. The country is also assumed to be small on the export side; the domestic price of sectoral exports is determined by the world price, exchange rate, and any applicable export tax (or subsidy).

The four components of sectoral demand are intermediate, consumption, investment, and government. Fixed input-output coefficients determine intermediate demand. Household consumption demand is based on the linear expenditure system. Inventory investment in volume terms is exogenous, while fixed investment is the difference between total investment and inventory demand in nominal terms. Government consumption of sectoral products is in fixed shares of total government consumption in volume terms.

Aside from the supply-demand balances in the product and factor markets, three macroeconomic balances are specified in the model: (i) the fiscal balance, showing that government savings is the difference between government revenue and spending; (ii) the external balance, equating the supply and demand for foreign exchange; and (iii) the equality between total investment and total savings. For purposes of simulating alternative industrial development paths, we specify a simple, neutral, macro closure whereby the ratios of investment and government consumption expenditures *in nominal terms* to total absorption are assumed to remain the same as in the base model.

IV. MODEL SIMULATIONS AND RESULTS

Our stylized representation of the Indonesian economy in the immediate post-crisis period is one in which net capital inflow and remittances to enterprises are reduced to zero which, based on the CGE model, is associated with a depreciation of the real exchange rate by about 30 percent from the 1995 benchmark. We modify the base model to reflect the changed economic structure after the crisis, which then represents the initial conditions that are perturbed by exogenous shocks corresponding to the alternative industrial development paths assumed in the model simulations. The simulation results should be interpreted therefore in reference to this post-shock base.

Implementation of the three industrialization strategies can be expected to have differential effects on two basic determinants of sectoral production: (1) the capital stock (land for agricultural sectors), as a result of domestic investments being made more attractive for the favored sectors; and (2) total factor productivity (TFP), related to the likely improvement in sectoral infrastructure and support services. Specifically, capital and land investments of Rp 30 trillion (in 1995 prices) are postulated for the relevant sectors in the three simulations; also, an exogenous direct increase in real value added of Rp 30 trillion from sectoral TFP growth is assumed in each simulation experiment. Under the ADL industrialization scenario, output gains from land improvement and TFP growth will accrue to three production sectors (food crops, nonfood crops, and livestock), which are allocated in accordance with their land and value added shares, respectively. In a dynamic model, changes in sectoral capital stock and (perhaps) total factor productivity would be endogenously determined. Introducing "by hand" these assumed (direct) sectoral effects in our static CGE model allows us to examine, in an exploratory manner, the economy-wide income and equity effects of the three alternative industrialization paths for Indonesia.

The results of the three simulation experiments are shown in Table 4. They indicate deviations from the modified base values, given the simulated changes in the relevant sectors. The comparative effects on real GDP bear out the strong macro-linkages of agricultural growth. ADL industrialization is seen to generate a larger GDP increase than either the food processing-based (FPB) or light manufacturing-based (LMB) industrial growth path. The ADL advantage is even greater if it is assumed, as in the classical “vent-for-surplus” growth model, that output in the food

and nonfood crop sectors (dominated by rice and rubber, respectively) are fully tradable.[4] As can be discerned from the last row of the table, however, the share of manufacturing in GDP declines with ADL development and rises under FPB and (even more so) LMB industrialization.

The equity impact is not clear-cut. It is somewhat surprising that, except for the large increase in farm-worker household income, the ADL scenario is associated with lower real incomes of farm households.[5] The explanation is that the increases in agricultural output from the postulated total productivity growth and land improvement lead to a substantial terms of trade decline (by 21 percent from the modified base value). Preventing the latter from happening by the assumption of full tradability of crop output is seen to generate the expected favorable income effects for the three farm household groups relative to the rural nonfarm and urban households. Without the latter assumption, food processing-based industrial growth improves farm household incomes better than both the ADL and LMB scenarios; however, the equity impacts on rural nonfarm and urban households are unfavorable. A final observation is that LMB industrial growth leads not only to the lowest increase in real GDP among the three scenarios but also the most inequitable distribution of income gains — large-farm, rural nonfarm, high-income, and urban high-income households being the chief beneficiaries. This result is attributable to the relatively high proportion of factor payments in the light manufacturing sector in Indonesia accruing to higher-income households in the benchmark period.

[4] Meaning that the substitution elasticities between sectoral domestic product and imports, and also between domestic use and exports, are infinite.

[5] The large percentage changes in farm-worker household income shown in Table 4 arise in part from its very low initial value (only 3.2 percent of total household income in the modified base solution).

V. CONCLUSION

This paper has explored the economy-wide income and equity effects of three alternative industrial development paths for Indonesia, in a post-shock environment. The results of SAM multiplier analysis indicate relatively strong macro-linkages of agricultural demand-led industrialization, yielding a significantly larger increase in real GDP compared to that arising from industrial development oriented to either food processing or light manufacturing. Another important finding is that the three higher-income rural and urban household groups have smaller GDP and manufacturing output multipliers, suggesting that the distribution of income benefits is a potentially significant influence on growth of the national economy and the manufacturing sector.

The simulation results based on CGE modeling, which takes account of nonlinearities and supply constraints that are ignored in SAM analysis, bear out the dominant influence of demand linkages in showing that ADL industrialization is associated with a larger GDP increase than the two other industrial development paths. However, to preserve the income gains for farm households and improve equity, it would be necessary to prevent the agricultural terms of trade from deteriorating — for example, through improvement of the country's ability to export farm products. Otherwise, food processing-based industrial growth raises farm household income by more than the two other development scenarios. Finally, while industrialization based on light manufacturing shows the most significant increase in the ratio of manufacturing value added to GDP, it is also associated with the smallest GDP increase and the worst equity effect.

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Table 1. Aggregate SAM for Indonesia, 1995 (Trillions of Indonesian Rupiah)

		Expenditures										
		Value Added			Suppliers		Institutions					
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(12)	Total
	Value Added											
	(1) Labor				262							262
R	(2) Land				32							32
e	(3) Capital				217							217
	Suppliers											
c	(4) Activities					976					122	1,099
e	(5) Commodities				563		360		36	152		1,110
i	Institutions											
	(6) Households	262	32	92			2		8		6	402
p	(7) Enterprises			125							11	136
t	(8) Government				25	7	4	40			(6)	69
s	(9) Capital						37	43	25		47	152
	(10) World					127		53				180
	Total	262	32	217	1,099	1,110	403	136	69	152	180	

Table 2. Disaggregation of the benchmark Indonesian SAM for 1995

Activities/commodities (17)

Food crops	Other mining	Utilities
Other crops	Food processing	Trade and transport
Livestock	Light manufacturing	Banking
Forestry	Fertilizer	Public administration
Fishery	Other manufacturing	Other services
Oil	Construction	

Factors (6)

Agricultural labor
Nonagricultural labor: production, clerical, professional
Capital
Land

Households (7)

Rural: farm-worker, small-farm, large-farm, nonfarm low-income, nonfarm high-income
Urban: low-income, high-income

Table 3. Income multipliers by household group

	Gross domestic product	Manufacturing output
Rural households		
Farm-worker	1.673	1.560
Small-farm	1.614	1.505
Large-farm	1.569	1.378
Nonfarm low-income	1.601	1.514
Nonfarm high-income	1.538	1.457
Urban households		
Low-income	1.676	1.474
High-income	1.428	1.313

Table 4. CGE model simulation results of alternative industrialization paths
(in percent changes from modified base values)

	Agricultural demand-led (ADL)	Food processing-based (FPB)	Light manufacturing-based (LMB)
Real GDP	4.9 (6.4)	3.7	3.3
Household incomes			
Rural:			
Farm-worker	20.6 (92.6)	48.7	-7.1
Large-farm	-3.2 (16.5)	10.2	2.9
Small-farm	-3.2 (10.2)	6.2	9.0
Nonfarm, low-income	4.4 (9.2)	3.4	0.1
Nonfarm, high-income	0.6 (3.8)	7.8	15.2
Urban			
Low-income	13.3 (5.0)	0.0	-1.5
High-income	10.3 (4.7)	4.8	5.1
Manufacturing value added (at base prices)	3.0 (6.3)	4.6	5.5

Note: Numbers in parantheses are the corresponding results assuming that food and non-food crop sector products are fully tradable

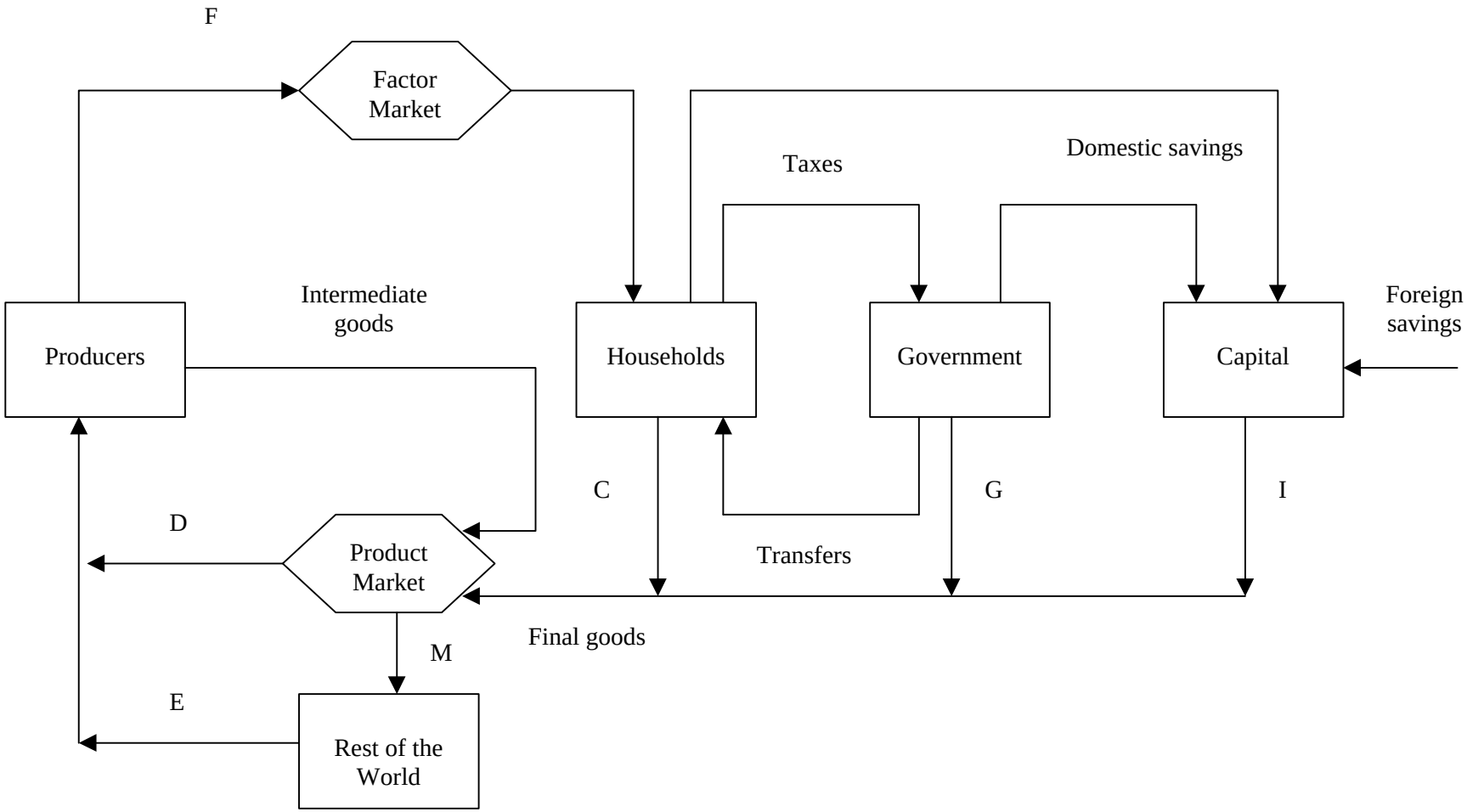
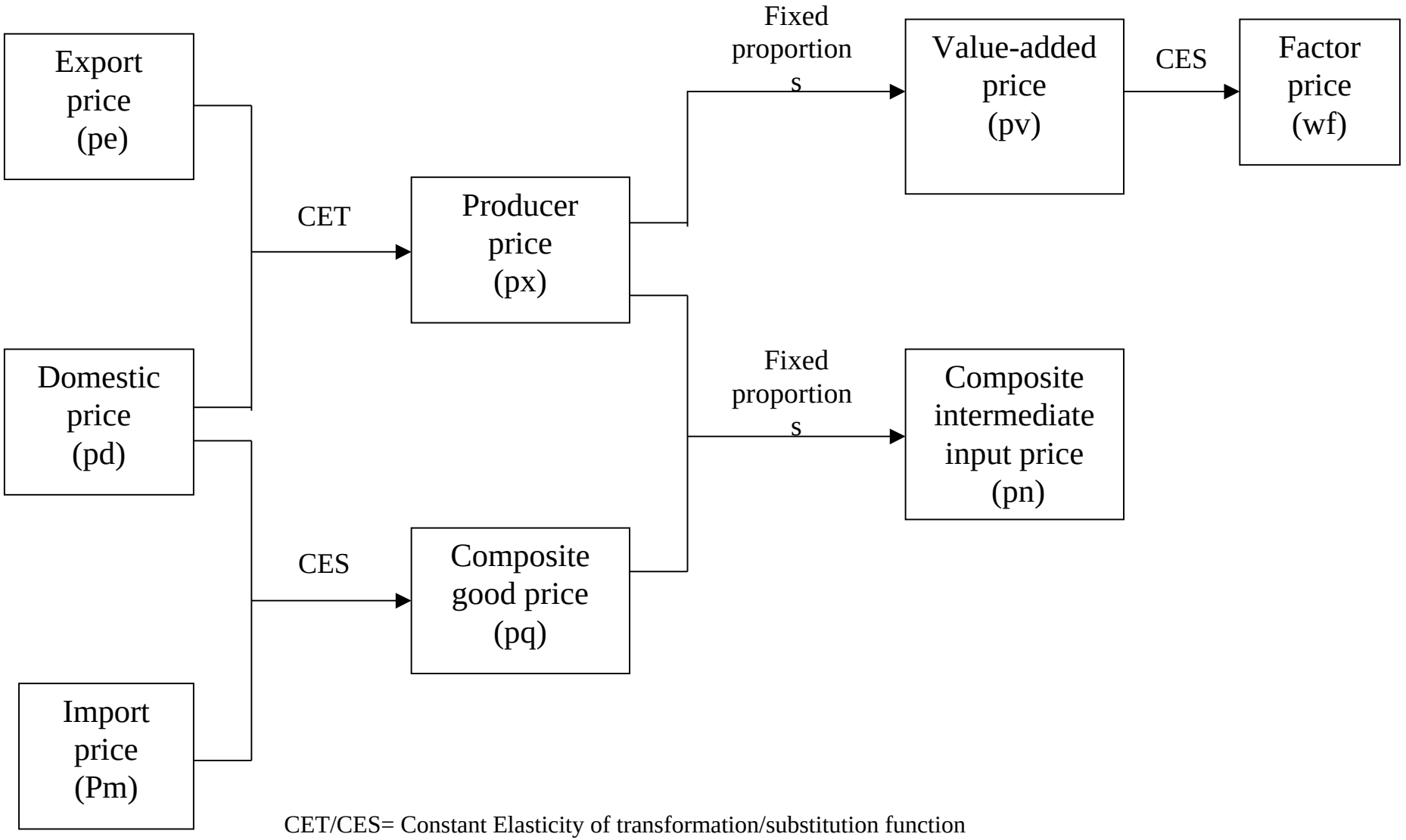


Figure 1. Economywide circular income flow



CET/CES= Constant Elasticity of transformation/substitution function

Figure 2. Domestic price transmission mechanism

APPENDIX TABLE A.1. Definition of Parameters and Variables in the CGE Model for Indonesia

Parameters

A a_i^c Armington function shift parameter

Install Equation Editor and double-click here to view equation. CES shift parameter

Install Equation Editor and double-click here to view equation. CES factor share parameter

Install Equation Editor and double-click here to view equation. CET function shift parameter

Install Equation Editor and double-click here to view equation. Input-output coefficients

B Install Equation Editor and double-click here to view equation. Capital composition matrix

Install Equation Editor and double-click here to view equation. Marginal budget shares (LES)

C Install Equation Editor and double-click here to view equation. Consumer price weights

D Install Equation Editor and double-click here to view equation. Armington function share parameter

Install Equation Editor and double-click here to view equation. Depreciation rates

Install Equation Editor and double-click here to view equation. Domestic sales price weights

E Install Equation Editor and double-click here to view equation. Base exchange rate (Rupiah per US dollar)

F Install Equation Editor and double-click here to view equation. Factors to household map

G Install Equation Editor and double-click here to view equation. CET function share parameter

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Install Equation Editor and double-click here to view equation. Government consumption shares

K Install Equation Editor and double-click here to view equation. Shares of investment by sector of destination

M Install Equation Editor and double-click here to view equation. Make matrix coefficients

P pvb_i Base value added price

Install Equation Editor and double-click here to view equation. Base import price

Install Equation Editor and double-click here to view equation. World market price of imports (in dollars)

Install Equation Editor and double-click here to view equation. World price of exports (in dollars)

Install Equation Editor and double-click here to view equation. Price index weights

Install Equation Editor and double-click here to view equation. Base output price

R Install Equation Editor and double-click here to view equation. Armington function exponent

Install Equation Editor and double-click here to view equation. CES production function exponent

Install Equation Editor and double-click here to view equation. CET function exponent

S Install Equation Editor and double-click here to view equation. Remittance shares

Install Equation Editor and double-click here to view equation. Government transfer shares

Install Equation Editor and double-click here to view equation. Share of enterprise income to households

Install Equation Editor and double-click here to view equation. Enterprise shares of factor income

Install Equation Editor and double-click here to view equation. Share of household income transferred to other households

T Install Equation Editor and double-click here to view equation. Consumption tax (+) or subsidy (-) rates

Install Equation Editor and double-click here to view equation. Tax (+) or subsidy (-) rates on exports

Install Equation Editor and double-click here to view equation. Household tax rate

Install Equation Editor and double-click here to view equation. Base tariff rate

tm_i Tariff rates on imports

Install Equation Editor and double-click here to view equation. Base indirect tax

Install Equation Editor and double-click here to view equation. Indirect tax rates

Y Install Equation Editor and double-click here to view equation. household to households map

Variables

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C for private consumption

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disposable income

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revenue

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D activity sales

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expenditure

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investment by sector of destination

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investment by sector

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E

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savings

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revenue

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transfers abroad

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savings rate

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rate

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EXR Exchange rate

Final demand

Household

Consumption tax

Domestic

Total depreciation

Volume of

Inventory

Exports

Enterprise

Enterprise tax

Enterprise

Enterprise

Enterprise tax

Export tax payments

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F foreign borrowing

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by sector

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abroad

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savings

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supply

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investment

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G market prices

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government consumption

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for government consumption

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consumption to total absorption ratio

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transfers to households

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Government revenue

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H savings

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Government

Factor demand

Labor transfers

Net foreign

Factor

Fixed capital

Value added in

Total volume of

Final demand

Government

Government savings

Government

Household

Household tax

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revenue

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I

Final demand for productive investment

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revenue

INT $_i$ Intermediates uses

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investment

Install Equation Editor and double-click here to view equation.

total absorption ratio

Install Equation Editor and double-click here to view equation.

M propensity to save by household

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

P

price of composite goods

Install Equation Editor and double-click here to view equation.

activity goods price

Install Equation Editor and double-click here to view equation.

commodity goods price

Install Equation Editor and double-click here to view equation.

price of exports

Install Equation Editor and double-click here to view equation.

index

Install Equation Editor and double-click here to view equation.

capital goods by sector of destination

Install Equation Editor and double-click here to view equation.

of imports

Install Equation Editor and double-click here to view equation.

composite good

Indirect tax

Total

Investment to

Marginal

Imports

Consumer

Domestic

Domestic

Domestic

Consumer price

Price of

Domestic price

Price of

Install Equation Editor and double-click here to view equation.

Value added price

Install Equation Editor and double-click here to view equation.

Average output price

Install Equation Editor and double-click here to view equation.

Q Composite goods supply

Install Equation Editor and double-click here to view equation.

R Remittances

Install Equation Editor and double-click here to view equation.

Enterprise remittances

Install Equation Editor and double-click here to view equation.

Real GDP

S ***SAVING*** Total savings

Install Equation Editor and double-click here to view equation.

Variable subsidy

Install Equation Editor and double-click here to view equation.

T Total absorption

Install Equation Editor and double-click here to view equation.

Tariff revenue

Install Equation Editor and double-click here to view equation.

W Factor price sectoral proportionality ratios

Install Equation Editor and double-click here to view equation.

Average factor price

Install Equation Editor and double-click here to view equation.

X Domestic output

Install Equation Editor and double-click here to view equation.

Y Enterprise income

Install Equation Editor and double-click here to view equation.

Factor income

Install Equation Editor and double-click here to view equation.

Household income

APPENDIX TABLE A.2. Price Equations

#	Equation	Description
1	Install Equation Editor and double-click here to view equation.	Import prices
2	Install Equation Editor and double-click here to view equation.	Export prices
3	Install Equation Editor and double-click here to view equation.	Export Price
4	Install Equation Editor and double-click here to view equation.	Definition of commodity prices
5	Install Equation Editor and double-click here to view equation.	Composite good prices
6	Install Equation Editor and double-click here to view equation.	Producer prices
7	Install Equation Editor and double-click here to view equation.	Value added prices net of indirect taxes
8	Install Equation Editor and double-click here to view equation.	Composite capital good prices
9	$PINDCON = \sum_i cwts_i \bullet PC_i$	Consumer price index

APPENDIX TABLE A.3. Quantity Equations

#	Equation	Description
10	Install Equation Editor and double-click here to view equation.	CES production function
11	Install Equation Editor and double-click here to view equation.	Demand function for primary factors (First order condition for profit maximization where Install Equation Editor and double-click here to view equation.
12	Install Equation Editor and double-click here to view equation.	Total intermediate use
13	Install Equation Editor and double-click here to view equation.	Commodity/activity relationship
14	Install Equation Editor and double-click here to view equation.	Gross domestic output as a composite good
15	Install Equation Editor and double-click here to view equation.	Gross domestic output
16	Install Equation Editor and double-click here to view equation.	Export supply
17	Install Equation Editor and double-click here to view equation.	Total supply for a composite good
18	Install Equation Editor and double-click here to view equation.	First order condition for cost minimization of composite goods

APPENDIX TABLE A.4. Income Equations

#	Equation	Description
19	Install Equation Editor and double-click here to view equation.	Factor income
20	Install Equation Editor and double-click here to view equation.	Capital income
21	Install Equation Editor and double-click here to view equation.	Household income
22	Install Equation Editor and double-click here to view equation.	Household disposable income
23	Install Equation Editor and double-click here to view equation.	Tariff revenue
24	Install Equation Editor and double-click here to view equation.	Consumption taxes
25	$INDTAX = \sum_i tx_i \bullet PX_i \bullet X_i$	Indirect taxes
26	Install Equation Editor and double-click here to view equation.	Export tax
27	Install Equation Editor and double-click here to view equation.	Household taxes
28	Install Equation Editor and double-click here to view equation.	Depreciation expenditure
29	Install Equation Editor and double-click here to view equation.	Enterprise taxes
30	Install Equation Editor and double-click here to view equation.	Enterprise savings
31	Install Equation Editor and double-click here to view equation.	Household savings
32	Install Equation Editor and double-click here to view equation.	Government revenue
33	Install Equation Editor and double-click here to view equation.	Total savings

Note: f = set of factors
hh = h = set of households

APPENDIX TABLE A.5. Expenditure Equations

#	Equation	Description
34	Install Equation Editor and double-click here to view equation.	Private consumption
35	Install Equation Editor and double-click here to view equation.	Government consumption
36	Install Equation Editor and double-click here to view equation.	Fixed investment
37	Install Equation Editor and double-click here to view equation.	Real fixed investment by sector of destination
38	Install Equation Editor and double-click here to view equation.	Investment final demand by sector of origin

APPENDIX TABLE A.6. Market Clearing and Macro Economic Closures

#	Equation	Description
39	Install Equation Editor and double-click here to view equation.	Goods market equilibrium
40	Install Equation Editor and double-click here to view equation.	Factor market equilibrium
41	Install Equation Editor and double-click here to view equation.	Fiscal balance
42	Install Equation Editor and double-click here to view equation.	External balance
43	***SAVING = INVEST***	Saving- investment balance
44	Install Equation Editor and double-click here to view equation.	Value added including indirect taxes
45	Install Equation Editor and double-click here to view equation.	Total absorption
46	Install Equation Editor and double-click here to view equation.	Real GDP
47	Install Equation Editor and double-click here to view equation.	Government consumption to total absorption share
48	Install Equation Editor and double-click here to view equation.	Investment to total absorption share